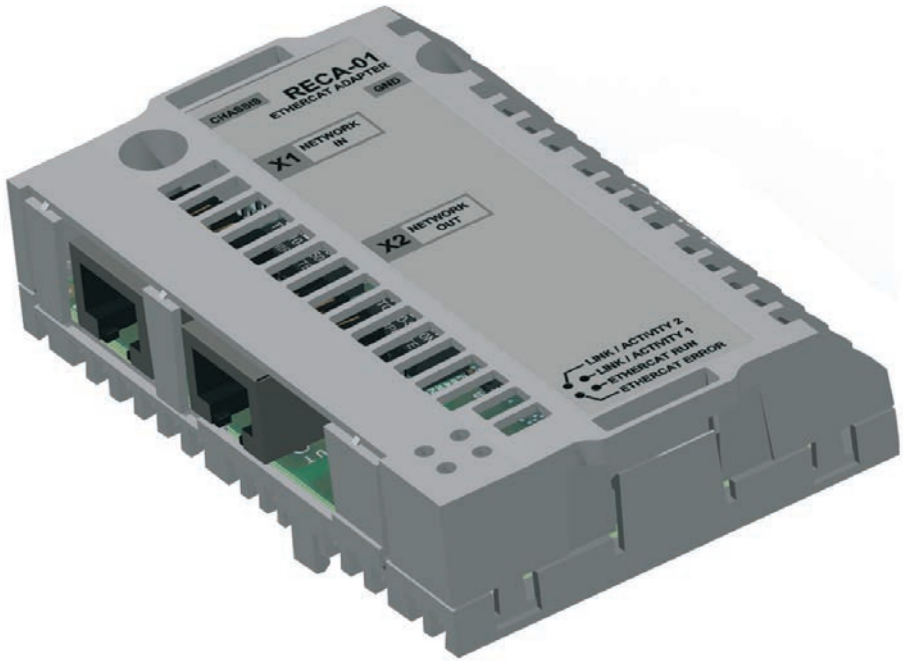
ABB Drives

User’s Manual
EtherCAT® Adapter Module
RECA-01



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EtherCAT® Adapter Module
RECA-01

User's Manual

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Safety instructions

What this chapter contains

This chapter states the general safety instructions that must be followed when installing and operating the RECA-01 EtherCAT® Adapter module.

The material in this chapter must be studied before attempting any work on the unit.

In addition to the safety instructions given below, read the complete safety instructions of the specific drive you are working on.

General safety instructions

WARNING! All electrical installation and maintenance work on the drive should be carried out by qualified electricians.

The drive and adjoining equipment must be properly earthed.

Do not attempt any work on a powered drive. After switching off the mains, always allow the intermediate circuit capacitors 5 minutes to discharge before working on the frequency converter, the motor or the motor cable. It is good practice to check (with a voltage indicating instrument) that the drive is in fact discharged before beginning work.

The motor cable terminals of the drive are at a dangerously high voltage when mains power is applied, regardless of motor operation.

There can be dangerous voltages inside the drive from external control circuits even when the drive mains power is shut off. Exercise appropriate care when working on the unit. Neglecting these instructions can cause physical injury or death.

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Introduction

What this chapter contains

This chapter contains a description of the User's manual for the RECA-01 EtherCAT® Adapter module.

Intended audience

The manual is intended for people responsible for commissioning and using an RECA-01 EtherCAT® Adapter module. The reader is expected to have a basic knowledge of electrical fundamentals, electrical wiring practices and how to operate the drive.

Before you start

It is assumed that the drive is installed and ready to operate before starting the installation of the extension module.

In addition to conventional installation tools, have the drive manuals available during the installation as they contain important information not included in this manual. The drive manuals are referred to at various points of this manual.

What this manual contains

This manual contains information on the wiring, configuration and the use of the RECA-01 EtherCAT® Adapter module.

It is assumed that the drive is installed and ready to operate before starting the installation of the adapter module. For more information on the installation and start-up procedures of the drive, see the appropriate drive manuals.

Safety instructions are featured in the first few pages of this manual.

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Overview contains a short description of the EtherCAT® protocol and the RECA-01 EtherCAT® Adapter module, a delivery checklist, and information on the manufacturer's warranty.

Quick start-up guide contains a short description of how to set up the RECA-01 EtherCAT® Adapter module.

Mechanical installation contains placing and mounting instructions for the module.

Electrical installation contains wiring and instructions.

Drive configuration explains how to program the drive before the communication through the adapter module can be started.

Master configuration explains how to program the EtherCAT® master before the communication through the adapter module can be started.

Communication profiles describes the communication profiles used in the communication between the EtherCAT® network, the RECA-01 module, and the drive.

Communication contains a description of how data is transmitted through the RECA-01 module.

Diagnostics explains how to trace faults with the status LEDs on the RECA-01 module.

CoE object dictionary describes the CANopen over EtherCAT® Object Dictionary used by the module.

CoE Error codes contains reference tables for decoding CoE error messages.

Definitions and abbreviations explains definitions and abbreviations concerning the EtherCAT® protocol family.

Technical data contains information on physical dimensions, connectors of the module and the specification of the EtherCAT® link.

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Terms used in this manual

Communication module

Communication module (often abbreviated COMM. MODULE or COMM.) is a parameter name / parameter selection name for a device (e.g. a fieldbus adapter) through which the drive is connected to an external serial communication network. The communication with the communication module is activated with a drive parameter (see the appropriate drive firmware manual).

Data sets and data words

Each data set consists of three 16-bit words, i.e. data words. The Control Word (sometimes called the Command Word) and the Status Word, References and Actual Values (see chapter *Communication profiles* on *page 33*) are types of data words; the contents of some data words are user-definable.

RECA-01 CANopen Adapter module

The RECA-01 CANopen Adapter module is one of the optional fieldbus adapter modules available for ABB drives. The RECA-01 is a device through which an ABB drive is connected to an EtherCAT® network.

Parameter

A parameter is an operating instruction for the drive. Parameters can be read and programmed with the drive control panel, or through the RECA-01 module.

Further information

Further information on the EtherCAT® protocol is available on the World Wide Web from www.ethercat.org

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Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type code and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to ABB website and selecting *Drives – World wide service contacts* on the right pane.

Product training

For information on ABB product training, navigate to ABB website and select *Drives – Training courses* on the right pane.

Providing feedback on ABB Drives manuals

Your comments on our manuals are welcome. Go to ABB website, then select successively *Drives – Document Library – Manuals feedback form* on the right pane.

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Overview

What this chapter contains

This chapter contains a short description of the EtherCAT® protocol and the RECA-01 EtherCAT® Adapter module, a delivery checklist and warranty information.

EtherCAT

EtherCAT® is a Real Time Ethernet technology which aims to maximize the utilization of the full duplex Ethernet bandwidth. It overcomes the overhead normally associated with Ethernet by employing "on the fly" processing hardware.

An EtherCAT® bus consists of a master system and up to 65535 slave devices, connected together with standard Ethernet cabling. The slave devices process the incoming Ethernet frames directly, extract or insert relevant data and transfer the frame to the next EtherCAT® slave device. The last slave device in the bus segment sends the fully processed frame back, so that it is returned by the first slave to the master as a kind of response frame.

There are several protocols that can be used as the application layer. One protocol technology applied to EtherCAT® - and RECA-01 - is CANopen, which defines SDOs (Service Data Objects), PDOs (Process Data Objects) and the Object Dictionary structure to manage the parameters.

Further information is available from the EtherCAT® technology group (www.ethercat.org).

RECA-01 EtherCAT® Adapter module

The RECA-01 EtherCAT® Adapter module is an optional device for ABB drives which enables the connection of the drive to an EtherCAT® network. Through the RECA-01 EtherCAT® Adapter module it is possible to

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- give control commands to the drive (Start, Stop, Run enable, etc.)
- feed a motor speed or torque reference to the drive
- give a process actual value or a process reference to the PID controller of the drive
- read status information and actual values from the drive
- reset a drive fault.

The EtherCAT® commands and services supported by the RECA-01 EtherCAT® Adapter module are discussed in the chapter *Communication* on *page 47*. Please refer to the user documentation of the drive as to which commands are supported by the drive.

The adapter module is mounted into an option slot on the motor control board if the drive. See the drive manuals for module placement options.

The module is classified as a full EtherCAT® slave.

Device Description files for ABB Drives are available through your local ABB representative and the ABB Library.

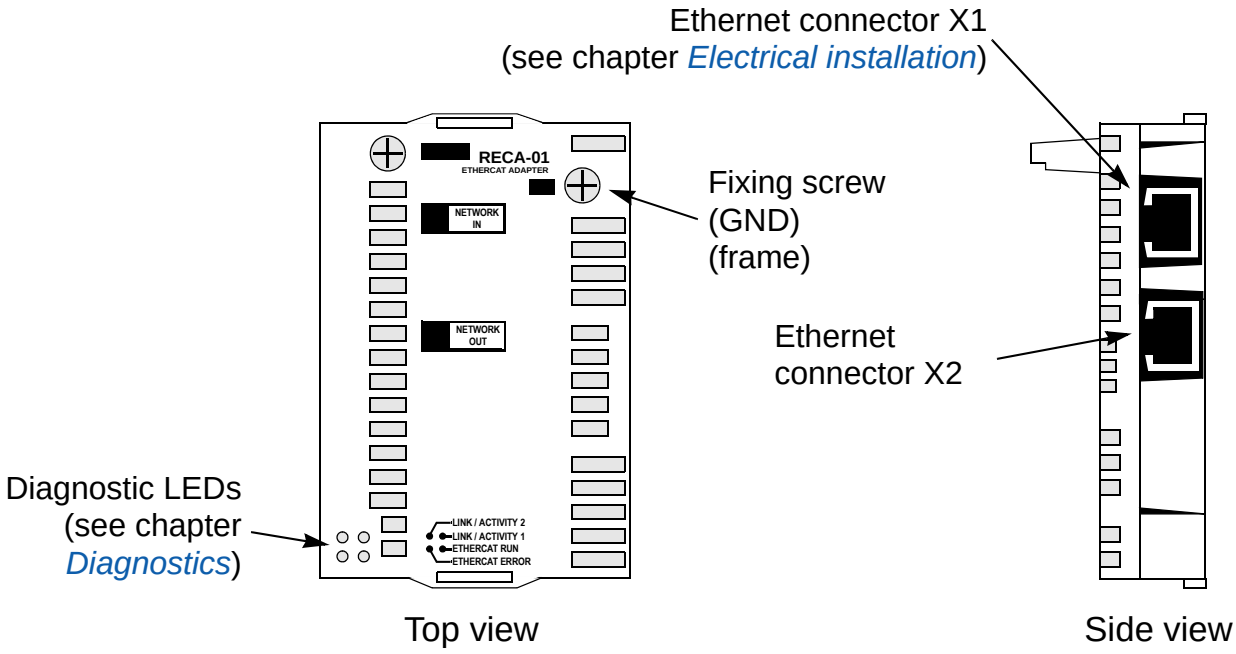

Figure 1. The RECA-01 Adapter module.

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Compatibility

The RECA-01 module is compatible with all master stations that support the EtherCAT® protocol.

Delivery check

The option package for the RECA-01 EtherCAT® Adapter module contains:

- EtherCAT® Adapter module, type RECA-01
- two screws (M3x10)
- this manual.

Warranty and liability information

The manufacturer warrants the equipment supplied against defects in design, materials and workmanship for a period of twelve (12) months after installation or twenty-four (24) months from date of manufacturing, whichever first occurs. The local ABB office or distributor may grant a warranty period different to the above and refer to local terms of liability as defined in the supply contract.

The manufacturer is not responsible for

- any costs resulting from a failure if the installation, commissioning, repair, alternation, or ambient conditions of the unit do not fulfil the requirements specified in the documentation delivered with the unit and other relevant documentation
- units subjected to misuse, negligence or accident
- units comprised of materials provided or designs stipulated by the purchaser.

In no event shall the manufacturer, its suppliers or subcontractors be liable for special, indirect, incidental or consequential damages, losses or penalties.

This is the sole and exclusive warranty given by the manufacturer with respect to the equipment and is in lieu of and excludes all other warranties, express or implied, arising by operation of law or

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otherwise, including, but not limited to, any implied warranties of merchantability or fitness for a particular purpose.

If you have any questions concerning your ABB drive, please contact the local distributor or ABB office. The technical data, information and specifications are valid at the time of printing. The manufacturer reserves the right to modifications without prior notice.

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Quick start-up guide

Overview

This chapter presents the steps to take during the start-up of the RECA-01 EtherCAT® Adapter module.

WARNING! Follow the safety instructions given in this manual and the *Hardware Manual* of the drive.

Mechanical installation

- Insert the RECA-01 into its specified slot in the drive (SLOT2 for ACS550, SLOT1 for ACS800).
- Fasten the two screws.

Electrical installation

- Connect the Ethernet cable (RJ-45 connector) to the RECA-01 module. Standard CAT 5 UTP or STP cables can be used. Avoid parallel runs with power (e.g. motor) cables.

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Drive configuration

Note: The detailed procedure of activating the drive for communication with the module is dependent on the drive type. Normally, a parameter must be adjusted to activate the communication. Refer to the *Firmware Manual* of the drive for information on the communication settings.

- Power up the drive.
- Configure the drive to communicate with the module. With an ACS550 drive, set parameter 98.02 COMM PROT SEL to EXT FBA. With an ACS800, set parameter 98.02 COMM. MODULE LINK to FIELDBUS.
- Verify that the drive parameter group 51 is activated and that parameter 51.01 FBA TYPE is ETHERCAT.
- Select either ABB Drives or DSP 402 communication with parameter 51.02. In ACS800, also set parameter 98.07 COMM PROFILE to ABB DRIVES or GENERIC (DSP 402).
- Initiate a "Fieldbus adapter parameter refresh" with parameter 51.27 FBA PAR REFRESH.
- Configure the drive to accept Start/Stop, Direction, Reference, Run Enable and Fault Reset from the module. Examples of appropriate values with ACS550 are shown in following tables *Example configuration with ACS550 using the ABB Drives profile* below and *Example configuration with ACS800 using the DSP 402 profile* on *page 21*.

Example configuration with ACS550 using the ABB Drives profile

Drive parameter	Example setting for ACS550
10.01 EXT1 COMMANDS	COMM
10.03 DIRECTION	REQUEST
11.02 EXT1/EXT2 SEL	EXT1
11.03 REF1 SELECT	COMM
16.01 RUN ENABLE	COMM
16.04 FAULT RESET SEL	COMM

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51.01 MODULE TYPE	ETHERCAT
51.02 TRANSPARENT/ PROFILE MODE	1 (TRANSPARENT, ABB DRIVES)
98.02 COMM PROT SEL	EXT FBA

Example configuration with ACS800 using the DSP 402 profile

Drive parameter	**Example setting for ACS800**
10.01 EXT1 STRT/STP/DIR	COMM.CW
10.03 REF DIRECTION	REQUEST
11.02 EXT1/EXT2/SELECT	EXT1
11.03 EXT REF1 SELECT	COMM.REF
16.01 RUN ENABLE	YES
16.04 FAULT RESET SEL	COMM.CW
51.01 MODULE TYPE	ETHERCAT
51.02 TRANSPARENT/ PROFILE MODE	0 (DSP 402)
98.02 COMM MODULE LINK	FIELDBUS
98.07 COMM PROFILE	GENERIC

Master system configuration

This section guides the user to configure the RECA-01 module in the EtherCAT® network using Beckhoff's TwinCAT System Manager. If you are using another master system, consult its manual for information on configuring the network.

- Select and import the Device Description File for the drive. EtherCAT® Device Description files are XML files containing configuration information of the drive. The files can be obtained from your local ABB representative or from ABB website.
- Add the drive to the network configuration either manually or by scanning subdevices (boxes) in the EtherCAT® device (see figure *Scan Boxes in TwinCAT* on *page 22*).

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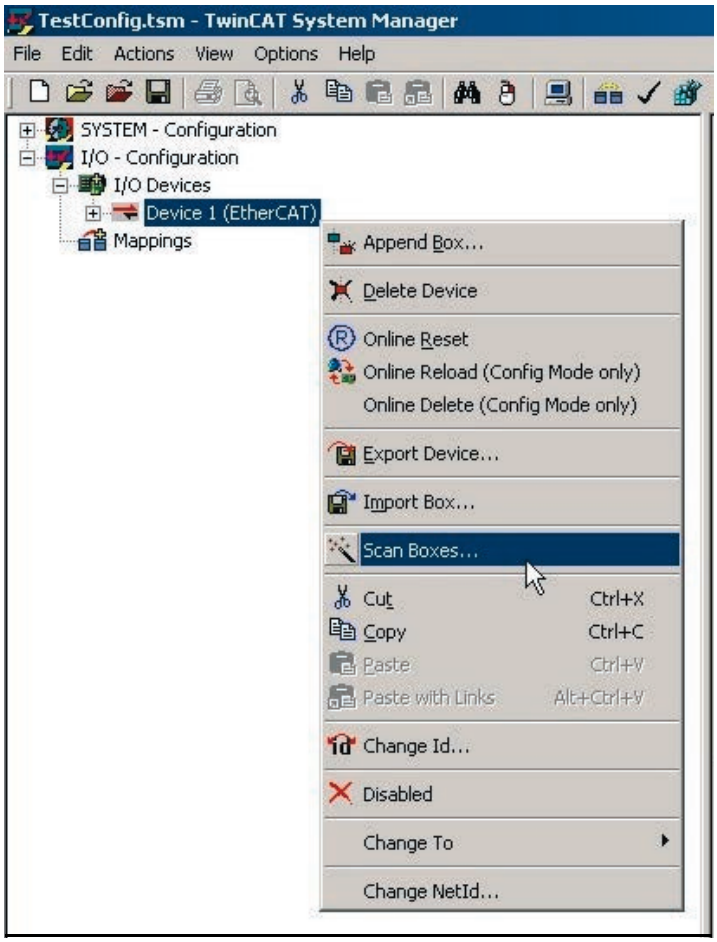

Figure 2. Scan Boxes in TwinCAT

- Select the "Process Data" tab of the drive in TwinCAT. PDOs can be configured and assigned to Sync Managers here (see figure *Configuring process data in TwinCAT* on *page 23*). Basic examples:
  - If you are using the DSP 402 communication profile, assign the default TxPDO 6 to the input assignment (0x1C13) and the default RxPDO 6 to the output assignment (0x1C12).
  - If you are using the ABB drives profile, assign the default TxPDO 21 to the input assignment (0x1C13) and the default RxPDO 21 to the output assignment (0x1C12).

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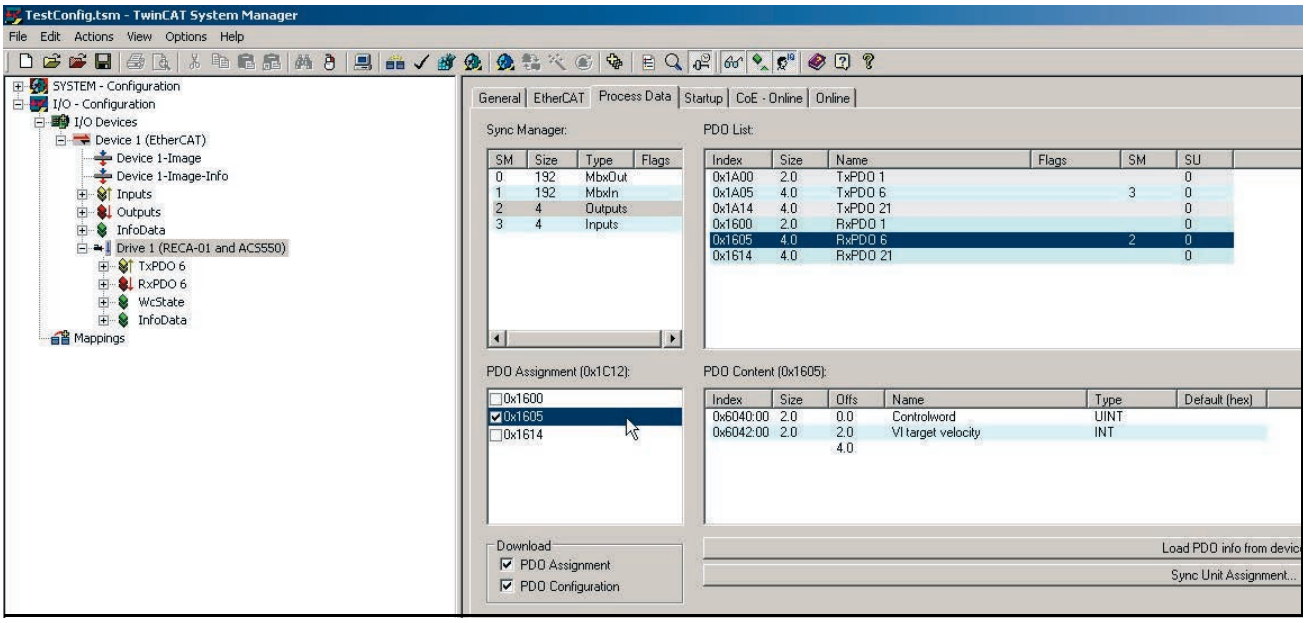

Figure 3. Configuring process data in TwinCAT

- The configuration will be transferred to the module when its state is changed from Pre-operational to Safe-operational. It might also be necessary to reload I/O devices (by pressing F4) in TwinCAT to apply the changes.

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Mechanical installation

What this chapter contains

This chapter contains placing and mounting instructions for the module.

WARNING! Follow the safety instructions given in this manual and in the appropriate drive hardware manual.

Mounting

The RECA-01 module is to be inserted into its specific position in the drive. The module is held in place with plastic retaining clips and two screws. The screws also provide the earthing of the CAT 5 STP cable shield connected to the module, and interconnect the GND signals of the module and the control board of the drive.

On installation of the module, the signal and power connection to the drive is automatically made through a 34-pin connector.

Mounting procedure:

- Insert the module carefully into its position inside the drive until the retaining clips lock the module into position.
- Fasten the two screws (included) to the stand-offs.

Note: Correct installation of the screws is essential for fulfilling the EMC requirements and for proper operation of the module.

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Electrical installation

What this chapter contains

This chapter contains

- general cabling instructions
- EtherCAT® connections.

WARNING! Before installation, switch off the drive power supply. Wait 5 minutes to ensure that the capacitor bank of the drive is discharged. Switch off all dangerous voltages connected from external control circuits to the inputs and outputs of the drive.

General cabling instructions

Arrange the bus cables as far away from the motor cables as possible. Avoid parallel runs. Use bushings at cable entries.

EtherCAT® connections

The network cables can be connected to the two RJ45 connectors (X1 and X2) on the RECA-01 module. Standard CAT 5 UTP, CAT 5 FTP or CAT 5 STP cables can be used. In case CAT 5 STP is used, the cable shield is internally connected to the drive frame through the module.

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Drive configuration

What this chapter contains

This chapter gives information on configuring the drive for operation with the RECA-01 EtherCAT® Adapter module.

RECA-01 configuration

After the RECA-01 EtherCAT® Adapter module has been mechanically and electrically installed according to the instructions in chapters *Mechanical installation* and *Electrical installation*, the drive must be prepared for communication with the module.

ABB drives can receive control information from multiple sources including digital inputs, analogue inputs, the drive control panel and a communication module (e.g. RETA-01). ABB drives allow the user to separately determine the source for each type of control information (Start, Stop, Direction, Reference, Fault Reset, etc.). In order to give the fieldbus master station the most complete control over the drive, the communication module must be selected as source for this information.The detailed procedure of activating the drive for communication with the module is dependent on the drive type. Normally, a parameter must be adjusted to activate the communication. Please refer to the drive documentation.

As communication between the drive and the RECA-01 is established, several configuration parameters are copied to the drive. These parameters must be checked first and adjusted if necessary (see table *The RECA-01 configuration parameters* on *page 30*). The alternative selections for these parameters are discussed in more detail below.

Note: The new settings take effect only when the module is powered up the next time or when the module receives a ‘Fieldbus Adapter parameter refresh’ (Drive parameter 51.27) command from the drive.

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The RECA-01 configuration parameters

Par. no.	Parameter name	Alternative settings	Default setting
1	MODULE TYPE	(Read-only)	ETHERCAT
2	TRANSPARENT/ PROFILE MODE	(**0**) Profile mode (DSP 402) (**1**) Transparent mode (ABB Drives)	**(0)** Profile mode (DSP 402)

1 MODULE TYPE

This parameter shows the module type as detected by the drive. The value cannot be adjusted by the user.

If this parameter is undefined, the communication between the drive and the module has not been established.

2 TRANSPARENT/PROFILE MODE

This parameter is used for choosing either the transparent (ABB Drives) or the DSP 402 communication profile. This selection can also be changed with CoE object 0×2400 (hex).

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Master configuration

What this chapter contains

This chapter gives information on configuring the EtherCAT® master to communicate with the RECA-01 EtherCAT® Adapter module.

Configuring the system

After the RECA-01 EtherCAT® Adapter has been mechanically and electrically installed according to the instructions in previous chapters and initialized by the drive, the master system must be prepared for communication with the module.

Please refer to the master system documentation for more information.

Device Description Files

Device Description Files are XML files that specify the properties of the slave device for the EtherCAT® master. The description files contain information on the supported communication objects. Device Description Files for ABB Drives are available through your local ABB representative and the ABB Library.

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Communication profiles

What this chapter contains

This chapter describes the communication profiles used in the communication between the EtherCAT® network, the RECA-01 module, and the drive.

Communication profiles

Communication profiles are ways of conveying control commands (Control word, Status word, references and actual values) between the master station and the drive.

With the RECA-01 module, the either master may employ either the CANopen DSP 402 (Device Profile Drives and Motion Control) profile or the ABB Drives profile. The Control Word, Status Word, references and actual values of these profiles are described in the following sections.

The CANopen device profile DSP 402

This section describes the basic functionality of the DSP 402 profile. The DSP 402 is a standardized device profile used for digital controlled motion products (e.g. frequency converters) and is part of the CANopen specification. Additional information can be obtained from CAN-CIA website.

Device Control state machine

The start and stop of the drive and several mode specific commands are executed by the Device Control state machine. This is described in figure *State machine, DSP 402 communication profile* on *page 38.* The Control Word is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master to the drive through the adapter module. The drive switches between its states according to the

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bit-coded instructions in the Control Word, and returns status information to the master in the Status Word.

Supported mode of operation

The DSP 402 profile offers a choice of several modes of operation. These modes define the operation of the drive. RECA-01 supports Velocity mode, which is a basic operation mode used to control the velocity of the drive.

Control Word and Status Word of the DSP 402 profile

The functionality of the Control Word is described in tables *Control Word of DSP 402* below and *Operation of bits 0…3 and 7 of the DSP 402 Control Word* on *page 35*. The functionality of the Status Word is described in table *Status Word of DSP 402* on *page 36*. The Control Word can be found in CoE object 0x6040 (hex) and the Status Word in CoE object 0x6041 (hex) (see chapter *CoE object dictionary page 59*).

Control Word of DSP 402

Bit	Name	Value	Description
0	Switch ON		The functionality of bits 0…3 and 7 are described in table *Operation of bits 0…3 and 7 of the DSP 402 Control Word* on *page 35*.
1	Enable voltage		
2	Quick stop		
3	Enable operation		
4	Ramp function generator enable.	0	Force ramp function generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
		1	**Normal operation:** Velocity reference is the output value of the ramp function generator.
5	Ramp function generator unlock.	0	Ramp function generator output value is locked to the current output value.
		1	**Normal operation:** Ramp output value follows ramp input value.

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Bit	Name	Value	Description
6	Ramp function generator use ref.	0	Ramp function generator input value is set to zero.
		1	**Normal operation:** Ramp function generator input is the ramp reference.
7	Fault reset		The functionality of bits 0…3 and 7 are described in table *Operation of bits 0…3 and 7 of the DSP 402 Control Word*.
8	Halt (not used)		
9…10	Reserved		
11…15	Drive specific (not used)		

Operation of bits 0…3 and 7 of the DSP 402 Control Word

Command	Control Word bit					
	Fault reset bit 7	**Enable operation bit 3**	**Quick stop bit 2**	**Enable voltage bit 1**	**Switch on bit 0**	**State transitions ***
Shut down	0	X	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on	0	1	1	1	1	3 (+4)**
Disable voltage	0	X	X	0	X	7, 9, 10, 12
Quick stop	0	X	0	1	X	7, 10, 11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4
Fault reset		X	X	X	X	15

X: Bits marked with X are irrelevant

* See figure *State machine, DSP 402 communication profile* on *page 38.*

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** When Control Word bit 3 (Enable operation) is 1, the drive does not stay in the SWITCHED ON state, but immediately transitions to state OPERATION ENABLED.

Status Word of DSP 402

Bit	Name	Value	Description
0	Ready to switch ON	0	Not ready to switch ON
		1	Ready to switch ON
1	Switched ON	0	Not switched ON
		1	Switched ON
2	Operation enabled	0	Operation not enabled
		1	Operation enabled
3	Fault	0	No fault
		1	Fault
4	Voltage enabled	0	No high voltage applied to drive
		1	High voltage applied to drive
5	Quick stop	0	Quick stop is active
		1	Normal operation
6	Switch on disabled	0	Switch on enabled
		1	Switch on disabled
7	Warning	0	No warning/alarms
		1	Warning/Alarm is active
8	Drive specific	0	ACx550: No External Run Enable signal received
		1	ACx550: External Run Enable signal received ACS800: User settable*
9	Remote	0	Drive control location: REMOTE (EXT1 or EXT2)
		1	Drive control location: LOCAL
10	Target reached	0	Actual value equals reference
		1	Actual value differs from reference
11	Internal limit active	0	Internal limit not active
		1	Internal limit active

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Bit	Name	Value	Description
12…13	Reserved		
14	Drive specific	0	ACx550: External control location EXT1 selected
		1	ACx550: External control location EXT2 selected ACS800: User settable*
15	Drive specific	0	ACx550: Not used ACS800: User settable*

* The functionality of the vendor-specific bits in ACS800 can vary according to the control program. In the Standard control program the bits are configured with drive parameters 92.07, 92.08 and 92.09.

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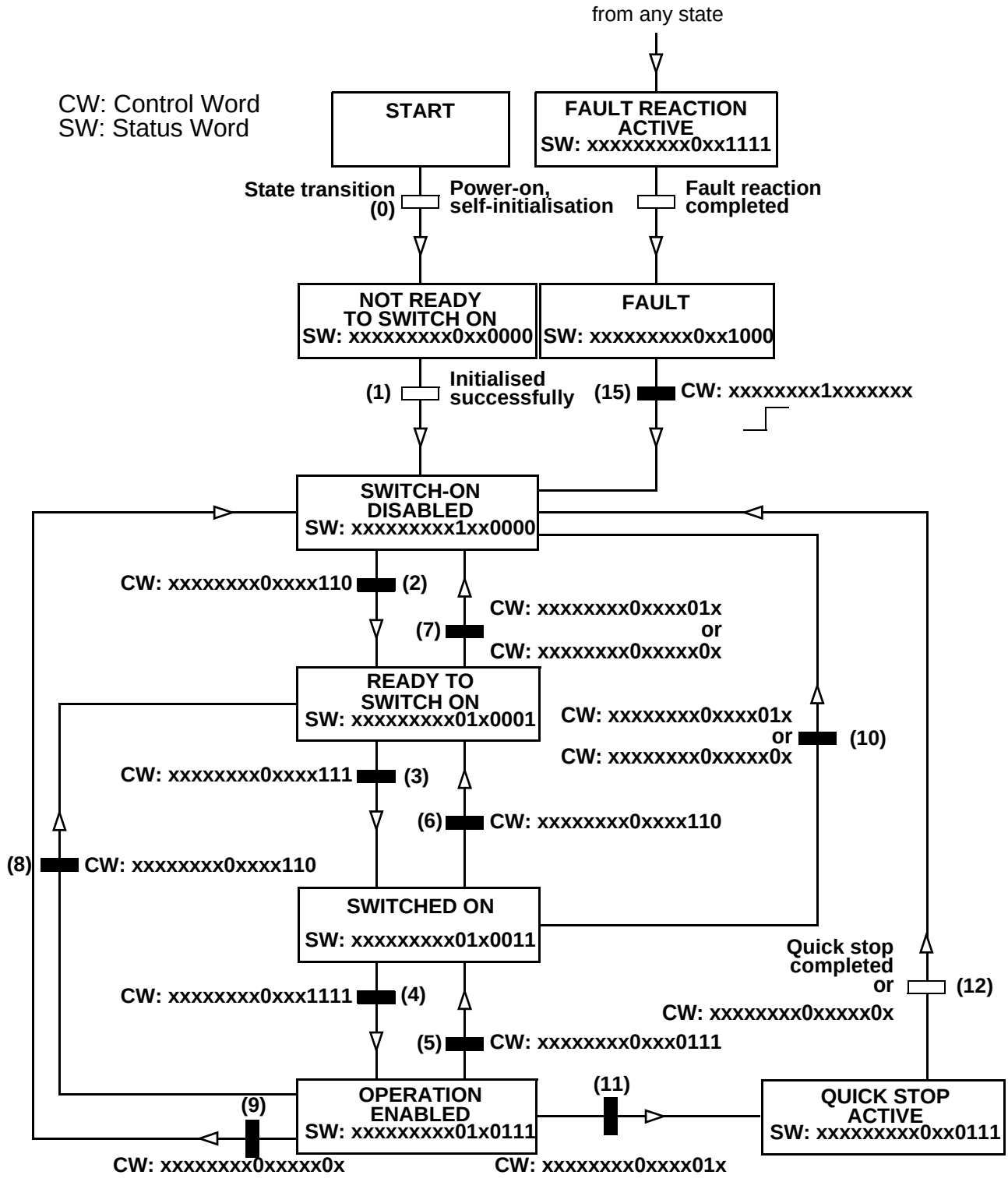

Figure 4. State machine, DSP 402 communication profile

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Reference of the DSP 402 profile

In the velocity operation mode, the reference is called Target velocity (CoE object 0x6042 hex). It is a 16-bit word containing a sign bit and a 15.bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference. The reference is used to control the speed of the drive.

The unit of the target velocity is rpm. This value can be scaled with the Vl dimension factor object (CoE object 0x604C hex):

Reference to drive = Target velocity * Vl dimension factor

The scaling is 1 by default.

Actual value of the DSP 402 profile

In the velocity operation mode, the actual value is called Control effort (CoE object 0x6044 hex). It is a 16-bit word containing a sign bit and a 15.bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference. The actual value is used by the master to monitor the actual speed of the drive.

The unit of the control effort is rpm. This value can be scaled with the Vl dimension factor object (CoE object 0x604C hex):

Drive actual speed = Control effort * Vl dimension factor

The scaling is 1 by default.

ABB Drives communication profile

The control word and the status word

The Control Word is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master station to the drive through the adapter module. The drive switches between its states according to the bit-coded instructions on the Control Word, and returns status information to the master in the Status Word.

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The contents of the Control Word and the Status Word are detailed in tables *Control Word of ABB Drives profile* and *Status Word of the ABB Drives profile* respectively. The drive states are presented in the ABB Drives profile state machine (see figure *State machine, ABB Drives communication profile* on *page 44*). The ABB Drives profile Control Word can be found in CoE object 0x2005 (hex) (Transparent Control Word) and the Status Word in CoE object 0x2007 (hex) (Transparent Status Word).

Control Word and Status Word of the ABB Drives profile

The following table presents the Control Word of the ABB Drives communication profile. The upper case boldface text refers to the states shown in figure *State machine, ABB Drives communication profile* on *page 44*.

Control Word of ABB Drives profile

Bit	Name	Value	STATE/Description
0	OFF1_ CONTROL	1	Proceed to **READY TO OPERATE**.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	OFF2_ CONTROL	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**.
2	OFF3_ CONTROL	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by drive parameter. Proceed to **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED**. **Warning:** Ensure motor and driven machine can be stopped using this stop mode.

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Control Word of ABB Drives profile

Bit	Name	Value	STATE/Description
3	INHIBIT_ OPERATION	1	Proceed to **OPERATION ENABLED**. **Note:** Run enable signal must be active; see the drive manuals. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	RAMP_OUT_ ZERO	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp Function Generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Proceed to **OPERATING**. **Note:** Effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp Function Generator input to zero.
7	RESET	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** Effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Continue normal operation.
8 to 9	Reserved.		

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Control Word of ABB Drives profile

Bit	Name	Value	STATE/Description
10	REMOTE_CMD	1	Fieldbus control enabled
		0	Control Word <> 0 or Reference <> 0: Retain last Control Word and Reference. Control Word = 0 and Reference = 0: Fieldbus control enabled. Reference and deceleration/ acceleration ramp are locked.
11	EXT_CTRL_LOC	1	Select External Control Location EXT2. Effective if control location is parameterised to be selected from fieldbus.
		0	Select External Control Location EXT1. Effective if control location is parameterised to be selected from fieldbus.
12 to 15	Reserved		

The following table presents the Status Word of the ABB Drives communication profile. The upper case boldface text refers to the states shown in figure *State machine, ABB Drives communication profile* on *page 44*.

Status Word of the ABB Drives profile

Bit	Name	Value	STATE/Description
0	RDY_ON	1	**READY TO SWITCH ON**
		0	**NOT READY TO SWITCH ON**
1	RDY_RUN	1	**READY TO OPERATE**
		0	**OFF1 ACTIVE**
2	RDY_REF	1	**OPERATION ENABLED**
		0	**OPERATION INHIBITED**
3	TRIPPED	1	**FAULT**
		0	No fault

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Status Word of the ABB Drives profile

Bit	Name	Value	STATE/Description
4	OFF_2_STA	1	OFF2 inactive
		0	**OFF2 ACTIVE**
5	OFF_3_STA	1	OFF3 inactive
		0	**OFF3 ACTIVE**
6	SWC_ON_ INHIB	1	**SWITCH-ON INHIBITED**
		0	–
7	ALARM	1	Warning/Alarm
		0	No warning/alarm
8	AT_ SETPOINT	1	**OPERATING**. Actual value equals reference = is within tolerance limits, i.e. in speed control, speed error is 10% max. of the nominal motor speed.
		0	Actual value differs from reference = is outside tolerance limits.
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2)
		0	Drive control location: LOCAL
10	ABOVE_ LIMIT	1	Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation.
		0	Actual frequency or speed within supervision limit
11	EXT_CTRL_ LOC	1	External Control Location EXT2 selected
		0	External Control Location EXT1 selected
12	EXT_RUN_E NABLE	1	External Run Enable signal received
		0	No External Run Enable signal received
13 to 14	Reserved		
15		1	Communication error detected by fieldbus adapter module
		0	Fieldbus adapter communication OK

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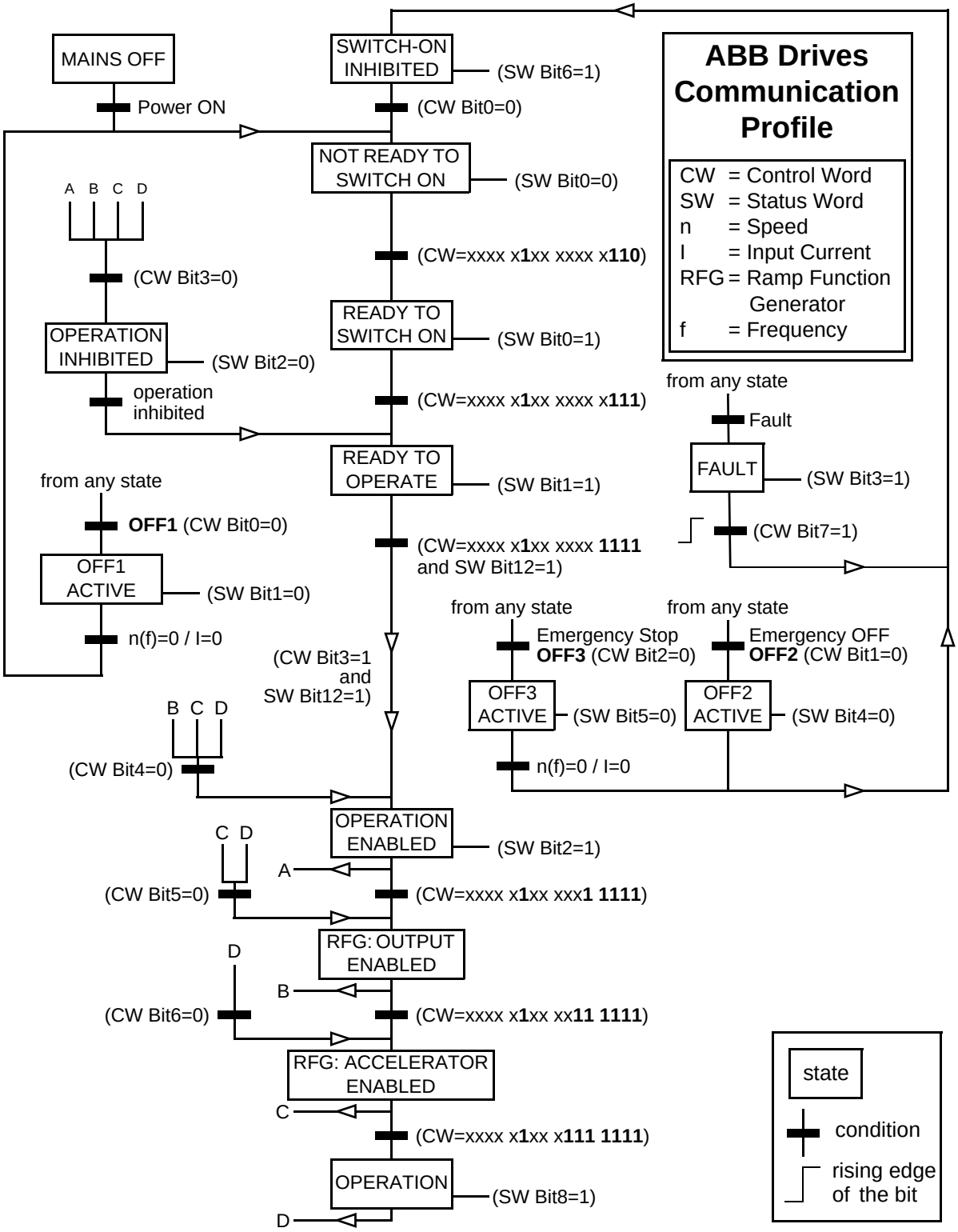

Figure 5. State machine, ABB Drives communication profile

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References

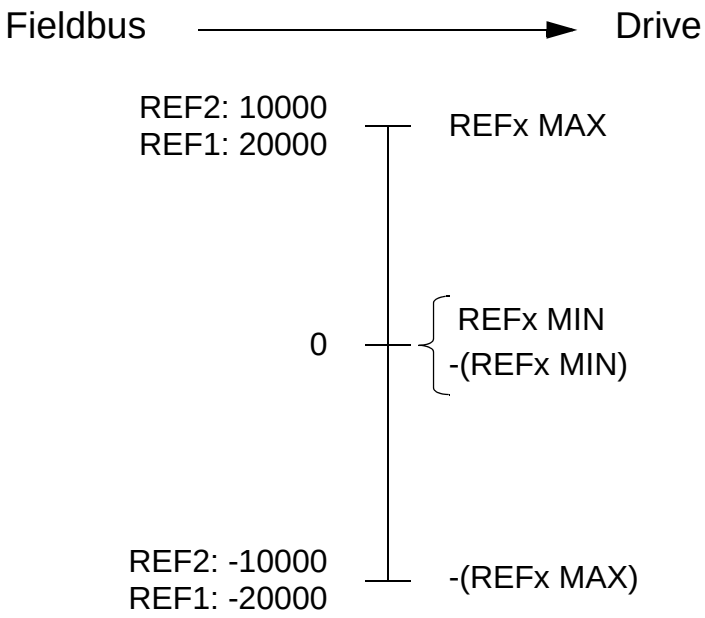
References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two’s complement from the corresponding positive reference. The ABB Drives profile reference can be found in CoE objects 0×2006 (hex) (Transparent Reference) and 0×4000 (hex), subindex 3 (Reference 2).

ABB drives can receive control information from multiple sources including analogue and digital inputs, the drive control panel and a communication module (e.g. RECA-01). In order to have the drive controlled through the fieldbus, the module must be defined as the source for control information, e.g. reference.

Scaling

References are scaled as shown below.

Note: The values of REF1 MAX and REF2 MAX are set by drive parameters. See the drive manuals for further information.



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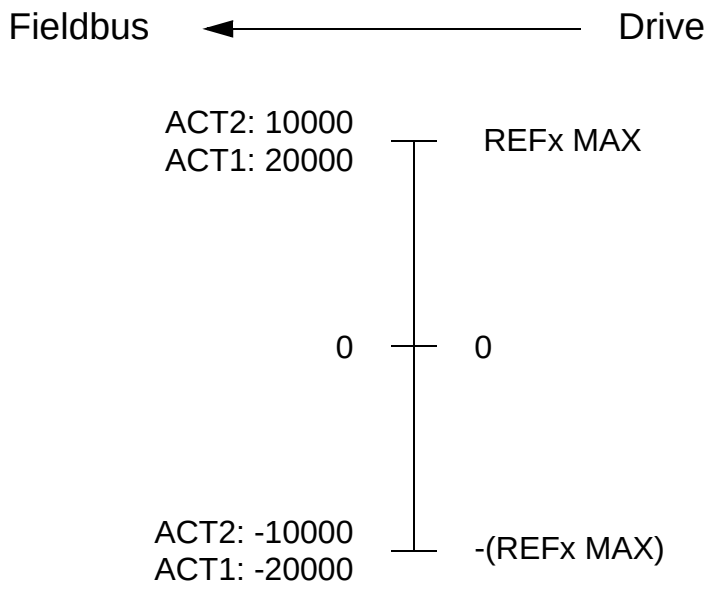
Actual values

Actual values are 16-bit words containing information on the operation of the drive. The functions to be monitored are selected by a drive parameter. The ABB Drives profile actual values can be found in CoE objects 0x2008 (hex) (Transparent Actual Value) and 0x4000 (hex), subindex 6 (Actual Value 2).

Scaling

Actual values are scaled as shown below.

Note: The values of REF1 MAX and REF2 MAX are set by drive parameters. See the drive manuals for further information.



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Communication

What this chapter contains

This chapter describes the communication on an EtherCAT® network.

EtherCAT® frame structure

In EtherCAT, the data between the master and the slaves is transmitted in Ethernet frames. An EtherCAT® Ethernet frame consists of one or several EtherCAT® telegrams, each addressing individual devices and/or memory areas. The telegrams can be transported either directly in the data area of the Ethernet frame or within the data section of an UDP datagram transported via IP. The EtherCAT® frame structure is pictured in following figure *EtherCAT® frame structure.* Each EtherCAT® telegram consists of an EtherCAT® header, the data area and a working counter, which is incremented by all EtherCAT® nodes that are addressed by the telegram and have exchanged associated data.

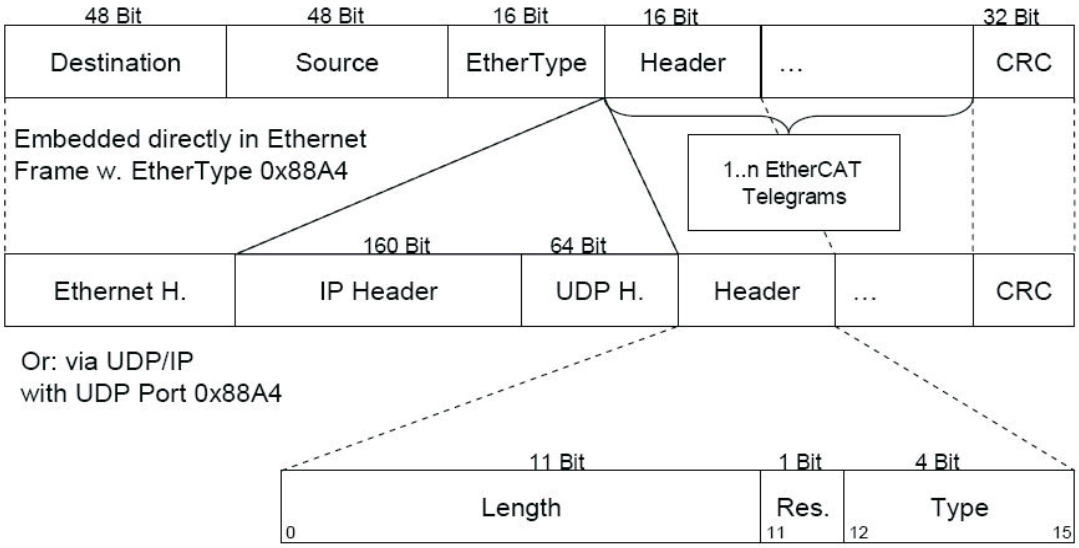

Figure 6. EtherCAT® frame structure.

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EtherCAT® Services

EtherCAT® specifies services for reading and writing data from the physical memory within the slaves. RECA-01 supports the following EtherCAT® services:

- Auto increment physical read (APRD)
- Auto increment physical write (APWR)
- Auto increment physical read write (APRW)
- Configured address read (FPRD)
- Configured address write (FPWR)
- Configured address read write (FPRW)
- Broadcast read (BRD)
- Broadcast write (BWR)
- Logical read (LRD)
- Logical write (LWR)
- Logical read write (LRW)
- Auto increment physical read multiple write (ARMW)
- Configured address read multiple write (FRMW)

Addressing modes and FMMUs

There are a number of different addressing modes which can be used by the master to communicate with EtherCAT® slaves. As a full slave, RECA-01 supports the following addressing modes:

Position addressing

The slave device is addressed via its physical position in the EtherCAT® segment.

Node addressing

The slave device is addressed via a configured node address assigned by the master during the start-up phase.

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Logical addressing

The slaves are not addressed individually, but instead a section of the segment wide 4 GB logical address space is addressed. This section may be used by any number of slaves.

Fieldbus Memory Management Units (FMMUs) handle the local assignment of physical slave memory addresses to logical segment wide addresses. The slave FMMUs are configured by the master. Each FMMU configuration contains a logical start address, a physical memory start address, a bit length and a type that specifies the direction of the mapping (input or output).

RECA-01 has four FMMUs. The EtherCAT® master can use them for any purpose.

Sync managers

Sync managers control the access to the application memory. Each channel defines a consistent area of the application memory. RECA-01 has four sync manager channels. Their functions are described below. The mailbox protocol and process data are described later in this chapter.

Sync manager channel 0

Sync manager 0 is used for mailbox write transfers (mailbox from master to slave). The module supports mailbox sizes between 50…256 bytes. The default is 192 bytes.

Sync manager channel 1

Sync manager 1 is used for mailbox read transfers (mailbox from slave to master). The module supports mailbox sizes between 50…256 bytes. The default is 192 bytes.

Sync manager channel 2

Sync manager 2 is used for process output data. It contains the Rx PDOs specified by the PDO assignment object 0x1C12 (hex).

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Sync manager channel 3

Sync manager 3 is used for process input data. It contains the Tx PDOs specified by the PDO assignment object 0x1C13 (hex).

Watchdogs

The RECA-01 module provides two watchdogs, with which the functionality of the module and connection can be monitored. The watchdogs are configured and enabled by the EtherCAT® master.

PDI watchdog

The PDI watchdog monitors the module's CPU. Each access from the CPU to the ESC (EtherCAT® Slave Controller) resets this watchdog.

Sync manager watchdog

The sync manager watchdog monitors the output sync managers. If the output I/O data is not updated by the master within the configured time the watchdog will timeout and reduce the state of the module from OP to SAFEOP. The resolution of this watchdog is 1 ms.

Note: EtherCAT® by design provides no way for a slave to monitor the connection to the master if the slave has no output data.

Note: The drive reaction to a communication fault must be configured separately. Consult the drive manual for more information.

EtherCAT® state machine

RECA-01 implements the EtherCAT® state machine mandatory for all EtherCAT® devices. The state machine is defined in following figure *EtherCAT® state machine*. The bootstrap state is not supported.

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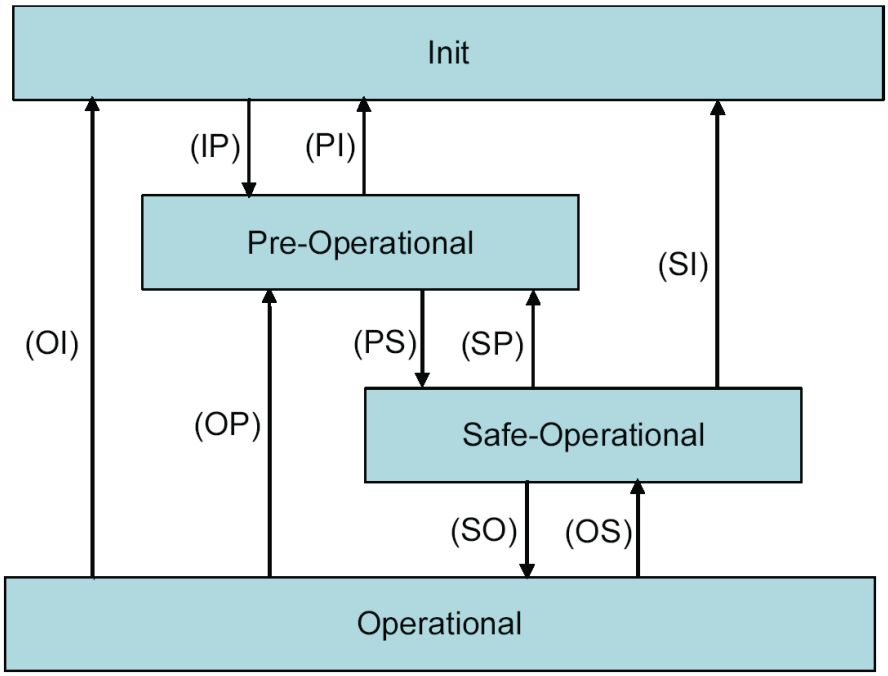

Figure 7. EtherCAT® state machine

The EtherCAT® module enters the INIT state directly after start-up. After this, the module can be switched to the PRE-OP state. In the PRE-OP state EtherCAT® mailbox communication is allowed and drive parameters can be accessed by CoE SDOs.

After the master has configured the slave it can switch the module to state SAFE-OP. In this state input I/O data (PDOs) is sent from the module to the EtherCAT® master, but there is no output I/O data from the master to the module.

In order to communicate Output I/O data the master must switch the module to the OP state.

CANopen over EtherCAT® (CoE)

The application layer communication protocol in EtherCAT® is based on the CANopen DS 301 communication profile and is called CANopen over EtherCAT, or CoE. The protocol specifies the Object Dictionary in the module, as well as communication objects for exchanging process data and acyclic messages.

RECA-01 implements the following message types:

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- Process Data Object (PDO)
  - The PDO object is used for cyclic I/O communication, i.e. process data.
- Service Data Object (SDO)
  - The SDO object is used for acyclic data transmission.
- Emergency Object (EMCY)
  - The EMCY object is used for error reporting when a fault has occurred in the drive or module.

The object dictionary is described in chapter *CoE object dictionary* on page *59*.

Process Data Objects (PDO)

Process Data Objects (PDOs) are used for exchanging time-critical process data between the master and the slave. Tx PDOs are used to transfer data from the slave to the master and Rx PDOs to transfer data from the master to the slave.

PDO mapping defines which application objects are transmitted inside a PDO. These typically include the Control and Status Words, References and Actual Values, but most CoE dictionary objects and drive parameters can be mapped for cyclical communication.

RECA-01 has three receive PDOs and three transmit PDOs. Each PDO can have 0…8 application objects mapped inside it. The default mappings for the PDOs are described in tables *Default receive PDO mapping* and *Default transmit PDO mapping* on page *53*. Changing the mapping of the PDOs is only possible in the pre-operational state.

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Default receive PDO mapping

Mapped object	Rx PDO 1	Rx PDO 6	Rx PDO 21
1	0×6040 (hex) Control Word	0×6040 (hex) Control Word	0×2005 (hex) Transparent Control Word
2		0×6042 (hex) vl target velocity	0×2006 (hex) Transparent reference

Default transmit PDO mapping

Mapped object	Tx PDO 1	Tx PDO 6	Tx PDO 21
1	0×6041 (hex) Status Word	0×6041 (hex) Status Word	0×2007 (hex) Transparent Status Word
2		0×6044 (hex) vl velocity actual value	0×2008 (hex) Transparent actual value

In EtherCAT, the PDOs are transported inside Sync Manager Channel objects. RECA-01 has two sync manager channels for process data: SM 2 for output data (Rx data) and SM 3 for input data (Tx data). Changing the Sync manager PDO assignments is only possible in the pre-operational state. RECA-01 does not support transmitting PDOs acyclicly via the Mailbox interface.

The Rx PDO mappings are configured with CoE objects 0x1600, 0x1605 and 0x1614 (hex) and Tx PDO mappings with objects 0x1A00, 0x1A05 and 0x1A14 (hex). The format of the PDO mapping is described in table *Format of the PDO mapping (example for drive parameter 12.02)* on page *54*. Rx and Tx Sync Manager PDO assignments are configured with CoE objects 0x1C12 and 0x1C13 (hex), respectively. By default, PDO1 is enabled and assigned to the sync managers.

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Format of the PDO mapping (example for drive parameter 12.02)

Type	MSB			LSB
UNIT 32	31 16	15 8	7 0	
Description	Index e.g 0×400C (hex) ≙ Drive parameter group 12 (16 bits)	Sub index e.g 2 ≙ Drive parameter group 12 (8 bits)	Object length in bits e.g 0×10 (hex) = 16 bits (8 bits)	

Note: The maximum number of I/O parameters that can be simultaneously mapped for cyclic communication depends on the drive type and application. For example, ACS800 supports 12 inputs and 12 outputs and ACS550 supports 15 outputs and 15 inputs.

Service Data Objects (SDOs)

Service Data Objects are mainly used for transferring non time-critical data, e.g. parameter values. EtherCAT® specifies both SDO services and SDO Information services: SDO services provide read/write access to the entries in the device CoE Object Dictionary. SDO Information services allow the Object Dictionary itself to be read. The services supported by RECA-01 are described in table *Supported SDO and SDO Information services* below.

Supported SDO and SDO Information services

Service	Function
SDO Download Expedited	Writes up to four octets to the slave.
SDO Download Normal	Writes up to a negotiated number of octets to the slave.
Download SDO Segment	Writes additional data if the object size is greater than the negotiated number of octets.
SDO Upload Expedited	Reads up to four octets from the slave.
SDO Upload Normal	Reads up to a negotiated number of octets from the slave.
Upload SDO Segment	Reads additional data if the object size is greater than the negotiated number of octets.

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Service	Function
Abort SDO Transfer	Server abort of service in case of an erroneous condition.
Get OD List	Reads a list of available indices.
Get Object Description	Reads details of an index.
Get Entry Description	Reads details of an subindex.

Emergency Objects (EMCYs)

Emergency objects are used for sending fault information from the communication module and the drive to the EtherCAT® network. They are transmitted whenever a fault occurs in the drive or the module. Only one emergency object is transmitted per fault. EMCY objects are transmitted via the Mailbox interface.

There are a number of error codes specified for different events. The error codes are listed in the chapter *CoE Error codes* on *page 73*.

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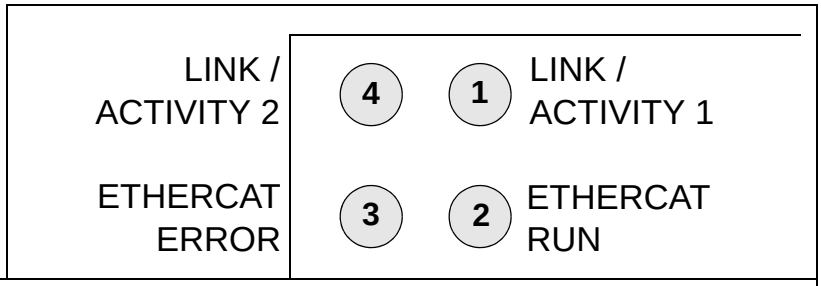
Diagnostics

LED indications

The RECA-01 module is equipped with four diagnostic LEDs. The description of the LEDs is presented below.



Name	Function
LED 1: LINK / ACTIVITY 1	**Off:** No link
	Green: Module is connected to Ethernet
	Flickering: There is traffic on Ethernet
The **green** EtherCAT RUN LED indicates the status of the EtherCAT® network state machine.	
LED 2: ETHERCAT RUN	**Off:** The device is in init state
	Green Blinking: The device is in pre-operational state. Flashing rate about 2.5 Hz.
	Green Single flash: The device is in safe-operational state. Single flash is one short flash (approx. 200 ms) followed by a long off phase (approx. 1000 ms).
	Green On: The device is in operational state.

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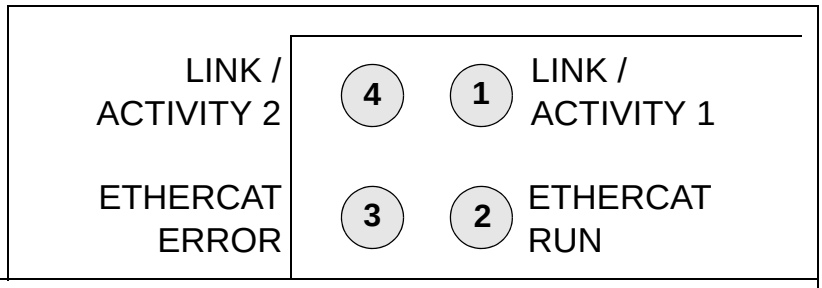

The **red** EtherCAT ERROR LED indicates the presence of any errors.	
LED 3: ETHERCAT ERROR	**Off:** No error
	Blinking: General Configuration Error
	Single flash: Slave device application has changed the EtherCAT® state autonomously: Parameter “Change” in the AL status register is set to 0×01 (hex):change/error. Single flash is one short flash (approx. 200 ms) followed by a long off phase (approx. 1000 ms).
	Double flash: A sync manager watchdog timeout has occurred. Double flash is two short flashes (approx. 200 ms each), separated by an off phase (approx. 200 ms), and then a long off phase (approx. 1000 ms).
	Five quick flashes: A configuration error has occurred, illegal configuration data set from drive is detected. A re-configuration followed by a new power cycle is needed to reset the CONFIG ERROR.
	On: A application watchdog timeout has occured.
LED 4: LINK / ACTIVITY 2	**Off:** No link
	Green: Module is connected to Ethernet
	Flickering: There is traffic on Ethernet

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CoE object dictionary

Overview

The CANopen over EtherCAT® (CoE) Object Dictionary contains all the configuration data of the RECA-01 module. The objects in the dictionary can be accessed with SDO services, and many of the dictionary objects can be mapped for cyclic communication in PDOs. Each object is addressed using a 16-bit index.

Communication profile objects

The objects in the communication profile section describe the basic EtherCAT® properties of the module and are common to all EtherCAT® slaves implementing the CoE communication protocol. The objects are described in following table *Communication profile objects*.

Communication profile objects

Index (hex)	Sub-index	Name	Type	Attri-bute	Information
0×1000	0	Device type	U32	RO	Describes the type of the device. Composed of two 16-bit fields (one for device profile, the other for additional information). The object value of the RECA-01 is 0×0192 (hex), which corresponds to drive profile DSP 402 (0×192 hex), and to additional information *Frequency Converter* (0×01 hex).
0×1008	0	Manufacturer device name	Visible string	RO	Device name. The constant string is RECA-01 and ACxxxx.
0×1009	0	Manufacturer hardware version	Visible string	RO	The hardware version of the module.

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Index (hex)	Sub-index	Name	Type	Attri-bute	Information
0×1010	0	Store parameters	U8	RO	Largest supported subindex. If the value of bit 0 of the subindexes is 1, the device saves parameters on command. Parameters can be saved by writing 0x65766173 ("evas") to the relevant subindex.
	1	Save all parameters	U32	RW	Stores all parameters to memory.
	2	Save communication (objects 0×1000 … 0×1A16) parameters	U32	RW	Communication parameters are not stored in the module.
	3	Save drive profile (objects 0×603F… 0×60FE, 0×2001… 0×200B) parameters	U32	RW	All profile parameters are saved.
	4	Save drive parameters	U32	RW	Store drive parameters.

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Index (hex)	Sub-index	Name	Type	Attri-bute	Information
0×1011	0	Restore default parameters	U8	RO	Largest supported subindex. Default parameters can be restored by writing 0x64616F6C ("daol") to the relevant sub index.
	1	Restore all parameters	U32	RW	Restore all parameters.
	2	Restore communication (objects 0×1000… 0×1A16) parameters	U32	RW	Communication parameters are not stored on the module.
	3	Restore drive profile (objects 0×603F… 0×60FE, 0×2001… 0×200B) parameters	U32	RW	Restore all DSP 402 parameters.
	4	Restore drive parameters	U32	RW	Restore drive default parameters.
0×1018	0	Identity object	U8	RO	Number of entries
	1	Vendor ID	U32	RO	Value: 0×B7 = ABB (Oy)
	2	Product code	U32	RO	Drive dependent, e.g. 0×201 = ACS550
	3	Revision	U32	RO	Module software revision, format 0×XXXX.XXXXh
	4	Serial number	U32	RO	Serial number of the module.

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Index (hex)	Sub-index	Name	Type	Attri-bute	Information
0×1600	0	Receive PDO1 Mapping	U8	RW	Number of mapped application objects (0…8).
	1	Mapped object #1	U32	RW	Default: 0×6040 Control Word
	n	Mapped object #n	U32	RW	Mapped objects 3…8 are empty by default.
0×1605	0	Receive PDO6 Mapping	U8	RW	Number of mapped application objects (0…8).
	1	Mapped object #1	U32	RW	Default: 0×6040 Control Word
	2	Mapped object #2	U32	RW	Default: 0×6042 VI target velocity
	n	Mapped object #n	U32	RW	Mapped objects 3…8 are empty by default.
0×1614	0	Receive PDO21 Mapping	U8	RW	Number of mapped application objects (0…8).
	1	Mapped object #1	U32	RW	Default: 0×2005 Transparent Control Word
	2	Mapped object #2	U32	RW	Default: 0×2006 Transparent reference
	n	Mapped object #n	U32	RW	Mapped objects 3…8 are empty by default.
0×1A00	0	Transmit PDO1 Mapping	U32	RW	Number of mapped application objects (0…8).
	1	Mapped object #1	U32	RW	Default: 0×6041 Status Word
	n	Mapped object #n	U32	RW	Mapped objects 2…8 are empty by default.

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Index (hex)	Sub-index	Name	Type	Attri-bute	Information
0×1A05	0	Transmit PDO6 Mapping	U8	RW	Number of mapped application objects (0…8).
	1	Mapped object #1	U32	RW	Default: 0×6041 Status Word
	2	Mapped object #2	U32	RW	Default: 0×6044 VI velocity actual value
	n	Mapped object #n	U32	RW	Mapped objects 3…8 are empty by default.
0×1A14	0	Transmit PDO21 Mapping	U8	RW	Number of mapped application objects (0…8).
	1	Mapped object #1	U32	RW	Default: 0×2007 Transparent Status Word
	2	Mapped object #2	U32	RW	Default: 0×2008 Transparent Actual Value
	n	Mapped object #n	U32	RW	Mapped objects 3…8 are empty by default.
0×1C00	0	Sync manager communication type	U8	RO	Number of entries
	1	Sync manager 0 communication type	U8	RO	Value: Mailbox write (1)
	2	Sync manager 1 communication type	U8	RO	Value: Mailbox read (2)
	3	Sync manager 2 communication type	U8	RO	Value: Process data out (3)
	4	Sync manager 3 communication type	U8	RO	Value: Process data in (4)

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Index (hex)	Sub-index	Name	Type	Attri-bute	Information
0×1C12	0	Sync manager Rx PDO assign	U8	RW	Number of assigned PDOs (0…3)
	1	Assigned PDO #1	U16	RW	
	2	Assigned PDO #2	U16	RW	
	3	Assigned PDO #3	U16	RW	
0×1C13	0	Sync manager Tx PDO assign	U8	RW	Number of assigned PDOs (0…3)
	1	Assigned PDO #1	U16	RW	
	2	Assigned PDO #2	U16	RW	
	3	Assigned PDO #3	U16	RW	

Manufacturer specific profile objects

The manufacturer specific profile object contains the ABB Drives profile Control and Status Words, Reference and Actual Value. In addition, objects for diagnostic data and PID configuration are included. The objects are described in table *Manufacturer specific profile objects* on *page 65*.

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Manufacturer specific profile objects

Index (hex)	Sub-index	Name	Type	Attri-bute	Information
0×2001	0	Velocity control parameter set	U8	RO	Number of entries
	1	Gain	U16	RW	Unit: 0.01
	2	Integration time constant	U16	RW	Unit: 0.1 s
	3	Derivation time constant	U16	RW	Unit: 0.1 s
	4	PID actual value	U16	RO	Unit: 0.1%
0×2002	0	Output power	U16	RO	Unit: 0.1 kW
0×2003	0	Drive temperature	U32	RO	Unit: 0.001 degrees Celsius
0×2004	0	Transparent / Profile mode	U8	RW	An object for choosing the communication profile 0 = Profile mode (DSP 402) 1 = Transparent (ABB Drives) profile mode This object can only be modified in the state PRE-OP.
0×2005	0	Transparent Control Word	U16	RW	See chapter *Communication profiles* on *page 33*.
0×2006	0	Transparent reference	INT16	RW	
0×2007	0	Transparent Status Word	U16	RO	
0×2008	0	Transparent actual feedback	INT16	RO	

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Index (hex)	Sub-index	Name	Type	Attri-bute	Information
0×200A	0	Vendor specific alarm codes	U8	RO	Number of entries See the drive manual for descriptions of the alarm codes.
	1	Alarm code 1 (latest)	U16	RO	
	2	Alarm code 2	U16	RO	
	3	Alarm code 3	U16	RO	
	4	Alarm code 4	U16	RO	
	5	Alarm code 5	U16	RO	
0×200B	0	Vendor specific fault codes	U8	RO	Number of entries See the drive manual for descriptions of the fault codes.
	1	Fault code 1 (latest)	U16	RO	
	2	Fault code 2	U16	RO	
	3	Fault code 3	U16	RO	
	4	Fault code 4	U16	RO	
	5	Fault code 5	U16	RO	

Drive data sets

With the CoE object 0x4000 (hex) the data set area of the drive can be accessed. The dictionary entry is described in following table *Drive data sets* on *page 67*.

Note: The total number of data sets and data words supported depends on the drive type and application program.

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Drive data sets

Index (hex)	Sub-index	Name	Type	Attri-bute	Information
0×4000	0	Number of entries		RW	Number of supported data sets depends on the application software of the drive.
	1	Control Word	U16	RW	Data set 1 Word 1
	2	Reference 1	INT16	RW	Data set 1 Word 2
	3	Reference 2	INT16	RW	Data set 1 Word 3
	4	Status Word	U16	RO	Data set 2 Word 1
	5	Actual Value 1	INT16	RO	Data set 2 Word 2
	6	Actual Value 2	INT16	RO	Data set 2 Word 3
	7	Reference 3	INT16	RW	Data set 3 Word 1
	8	Reference 4	INT16	RW	Data set 3 Word 2
	9	Reference 5	INT16	RW	Data set 3 Word 3
	A	Actual Value 3	INT16	RO	Data set 4 Word 1
	B	Actual Value 4	INT16	RO	Data set 4 Word 2
	C	Actual Value 5	INT16	RO	Data set 4 Word 3
	...	...	...	...	...
	62	Reference 49	INT16	RW	Data set 32 Word 2
	63	Reference 50	INT16	RW	Data set 32 Word 3

Drive actual signals and parameters

The actual signals and parameters available depend on the drive type. See the appropriate drive firmware manual for signal and parameter listings.

The Read service is used for reading actual signals and parameters from the drive. The Write service is used for writing parameter values to the drive. Both the Read and Write services

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use the same parameter mapping system. The CoE Dictionary Index equals drive parameter group in hexadecimal format + 4000 (hex) and the subindex is parameter index. For example, the index for the drive parameter 30.19 equals 1E (hex) + 4000 (hex) = 401E (hex) and the subindex = 19 (dec) = 13 (hex). The principle is demonstrated in following table *Drive signals and parameters*.

Note: Drive parameter values written through the network are not automatically saved to the permanent memory of the drive. A parameter save should be initiated in the drive to retain the changes after a power cycle.

Drive signals and parameters

Index (hex)	Subindex	Name	Type	Attribute	Information
4001	1	Drive signal 1.01	(1	(2	(3
	2	Drive signal 1.02	(1	(2	(3
• • •	• • •	• • •	• • •	• • •	• • •
4002	1	Drive signal 2.01	(1	(2	(3
• • •	• • •	• • •	• • •	• • •	• • •
4003	1	Drive signal 3.01	(1	(2	(3
• • •	• • •	• • •	• • •	• • •	• • •
400A	1	Drive par. 10.01	(1	(2	(3
	2	Drive par. 10.02	(1	(2	(3
• • •	• • •	• • •	• • •	• • •	• • •
400B	1	Drive par. 11.01	(1	(2	(3
• • •	• • •	• • •	• • •	• • •	• • •
4063	1	Drive par. 99.01	(1	(2	(3
• • •	• • •	• • •	• • •	• • •	• • •

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Index (hex)	Subindex	Name	Type	Attribute	Information
Subindex 0 = number of mapped objects. (1 U16, INT16, U32 or INT32 (2 Depends on parameter type of the drive. (3 See the appropriate drive firmware manual.					

DSP 402 profile objects

The DSP 402 profile objects describe objects for monitoring and controlling frequency controllers. The objects are described in the following table *DSP 402 profile objects*.

DSP 402 profile objects

Index (hex)	Sub-index	Name	Type	Attri-bute	Information
0×603F	0	Error code	U16	RO	See chapter *CoE Error codes* on *page 73*
0×6040	0	Controlword	U16	RW	See chapter *Communication profiles* on *page 33*
0×6041	0	Statusword	U16	RO	
0×6042	0	VI target velocity	INT16	RW	
0×6043	0	VI velocity demand	INT16	RO	Instantaneous velocity provided by the ramp function. Scaled to the value of the vl target velocity.
0×6044	0	VI velocity actual value	INT16	RO	See chapter *Communication profiles* on *page 33*
0×6046	0	VI velocity min max amount	INT8	RO	Number of entries
	1	VI velocity min amount	U32	RW	Velocity minimum amount
	2	VI velocity max amount	U32	RW	Velocity maximum amount

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Index (hex)	Sub-index	Name	Type	Attri-bute	Information
0×6048	0	VI velocity acceleration	INT8	RO	Number of entries Slope of the acceleration ramp = delta speed / delta time.
	1	Delta speed	U32	RW	
	2	Delta time	U16	RW	
0×6049	0	VI velocity deceleration	INT8	RO	Number of entries Slope of the deceleration ramp = delta speed / delta time.
	1	Delta speed	U32	RW	
	2	Delta time	U16	RW	
0×604A	0	VI velocity quick stop	INT8	RO	Number of entries Slope of the deceleration ramp = delta speed / delta time.
	1	Delta speed	U32	RW	
	2	Delta time	U16	RW	
0×604C	0	Vi dimensions factor	INT8	RO	Number of entries The dimension factor affects the scaling of other objects (0×6042, 0×6043, 0×6044, 0×6046, 0×6048, 0×6049, 0×604A). The parameter can only be modified in the PRE-OP state.
	1	VI dimensions factor numerator	INT32	RW	The numerator of the scaling factor. Default: 1
	2	VI dimensions factor denominator	INT32	RW	The denominator of the scaling factor. Default: 1
0×6060	0	Modes of operation	INT8	RW	The current mode of operation. Always set to 2 (Velocity mode).

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Index (hex)	Sub-index	Name	Type	Attri-bute	Information
0×6061	0	Modes of operation display	INT8	RO	A read only copy of object 0×6060
0×6078	0	Current actual value	INT16	RO	The actual output current

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CoE Error codes

What this chapter contains

This chapter contains a list of the CANopen over EtherCAT® error codes.

Error codes

Error codes can be read from the objects 0×200B and 0×603F (hex). Additionally, when the error occurs, an EMCY object containing the code is transmitted to the master. The module signals a cleared error (i.e. reset drive fault) with an EMCY object containing the error code 0x0000 (hex) "Error reset or no error". The CoE error codes are described in following table *CoE error codes*.

Error codes between xx80…xxFF (hex) and between FF00…FFFF (hex) are manufacturer specific. Descriptions for these error codes can be found in the appropriate drive firmware manual and/or the drive fault code parameter.

CoE error codes

Error code (hex)	Meaning
0000	Error reset or no error
1000	Generic error
2000	Current
2100	Current on device input side
2110	Short circuit / earth leakage
2120	Earth leakage
2121	Earth leakage phase L1
2122	Earth leakage phase L2
2123	Earth leakage phase L3
2130	Short circuit

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Error code (hex)	Meaning
2131	Short circuit phases L1-L2
2132	Short circuit phases L2-L3
2133	Short circuit phases L3-L1
2200	Internal current
2211	Internal current No. 1
2212	Internal current No. 2
2213	Overcurrent in ramp function
2214	Overcurrent in the sequence
2220	Continuous overcurrent
2221	Continuous overcurrent No. 1
2222	Continuous overcurrent No. 2
2230	Short circuit / earth leakage
2240	Earth leakage
2250	Short circuit
2300	Current on device output side
2310	Continuous overcurrent
2311	Continuous overcurrent No. 1
2312	Continuous overcurrent No. 2
2320	Short circuit / earth leakage
2330	Earth leakage
2331	Earth leakage phase U
2332	Earth leakage phase V
2333	Earth leakage phase W
2340	Short circuit
2341	Short circuit phases U-V
2342	Short circuit phases V-W
2343	Short circuit phases W-U
3000	Voltage
3100	Mains voltage
3110	Mains overvoltage
3111	Mains overvoltage phase L1

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Error code (hex)	Meaning
3112	Mains overvoltage phase L2
3113	Mains overvoltage phase L3
3120	Mains undervoltage
3121	Mains undervoltage phase L1
3122	Mains undervoltage phase L2
3123	Mains undervoltage phase L3
3130	Phase failure
3131	Phase failure L1
3132	Phase failure L2
3133	Phase failure L3
3134	Phase sequence
3140	Mains frequency
3141	Mains frequency too great
3142	Mains frequency too small
3200	DC link voltage
3210	DC link overvoltage
3211	Overvoltage No. 1
3212	Overvoltage No. 2
3220	DC link undervoltage
3221	Undervoltage No. 1
3222	Undervoltage No. 2
3230	Load error
3300	Output voltage
3310	Output overvoltage
3311	Output overvoltage phase U
3312	Output overvoltage phase V
3313	Output overvoltage phase W
3320	Armature circuit
3321	Armature circuit interrupted
3330	Field circuit
3331	Field circuit interrupted

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Error code (hex)	Meaning
4000	Temperature
4100	Ambient temperature
4110	Excess ambient temperature
4120	Too low ambient temperature
4130	Temperature supply air
4140	Temperature air outlet
4200	Temperature device
4210	Excess temperature device
4220	Too low temperature device
4300	Temperature drive
4310	Excess temperature drive
4320	Too low temperature drive
4400	Temperature supply
4410	Excess temperature supply
4420	Too low temperature supply
5000	Device hardware
5100	Supply
5110	Supply low voltage
5111	U1 = supply +/-15 V
5112	U2 = supply +24 V
5113	U3 = supply +5 V
5114	U4 = manufacturer specific
5115	U5 = manufacturer specific
5116	U6 = manufacturer specific
5117	U7 = manufacturer specific
5118	U8 = manufacturer specific
5119	U9 = manufacturer specific
5120	Supply intermediate circuit
5200	Control
5210	Measurement circuit
5220	Computing circuit

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Error code (hex)	Meaning
5300	Operating unit
5400	Power section
5410	Output stages
5420	Chopper
5430	Input stages
5440	Contactors
5441	Contactor 1 = manufacturer specific
5442	Contactor 2 = manufacturer specific
5443	Contactor 3 = manufacturer specific
5444	Contactor 4 = manufacturer specific
5445	Contactor 5 = manufacturer specific
5450	Fuses
5451	S1 = L1
5452	S2 = L2
5453	S3 = L3
5454	S4 = manufacturer specific
5455	S5 = manufacturer specific
5456	S6 = manufacturer specific
5457	S7 = manufacturer specific
5458	S8 = manufacturer specific
5459	S9 = manufacturer specific
5500	Data storage
5510	Working memory
5520	Program memory
5530	Non-volatile data memory
6000	Device software
6010	Software reset (Watchdog)
6100	Internal software
6200	User software
6300	Data record
6301	Data record No. 1

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Error code (hex)	Meaning
...	from 2…14 corresponding
630F	Data record No. 15
6310	Loss of parameters
6320	Parameter error
6330	EtherCAT® module configuration error
7000	Additional modules
7100	Power
7110	Brake chopper
7111	Failure brake chopper
7112	Overcurrent brake chopper
7113	Protective circuit brake chopper
7120	Motor
7121	Motor blocked
7122	Motor error or communication malfunc.
7123	Motor tilted
7200	Measurement circuit
7300	Sensor
7301	Tacho fault
7302	Tacho wrong polarity
7303	Resolver 1 fault
7304	Resolver 2 fault
7305	Incremental sensor 1 fault
7306	Incremental sensor 2 fault
7307	Incremental sensor 3 fault
7310	Speed
7320	Position
7400	Computation circuit
7500	Communication
7510	Serial interface no. 1
7520	Serial interface no. 2
7600	Data storage

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Error code (hex)	Meaning
8000	Monitoring
8100	Communication
8300	Torque control
8311	Excess torque
8312	Difficult start up
8313	Standstill torque
8321	Insufficient torque
8331	Torque fault
8400	Rotational speed controller
8500	Position controller
8600	Positioning controller
8611	Following error
8612	Reference limit
8700	Sync controller
8800	Winding controller
9000	External error
F000	Additional functions
F001	Deceleration
F002	Sub-synchronous run
F003	Stroke operation
F004	Control
FF00	Manufacturer specific
...	...
FFFF	Manufacturer specific

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Definitions and abbreviations

CoE

CANopen over EtherCAT; The use of the CANopen communication protocol over the basic EtherCAT® communication.

EMCY

Emergency Object; Used for transmitting information of errors that have occurred in a device.

Object Dictionary

A local storage of all communication objects recognized by the device.

OSI

Open Systems Interconnection.

PDO

Process Data Object; Used for transmitting time critical data, such as control commands, references and actual values.

RO

Denotes read-only access.

RW

Denotes read/write access.

SDO

Service Data Object; Used for transmitting non time critical data, such as parameters.

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Technical data

What this chapter contains

This chapter contains the technical specifications of the RECA-01 EtherCAT® Adapter module.

RECA-01

Enclosure:

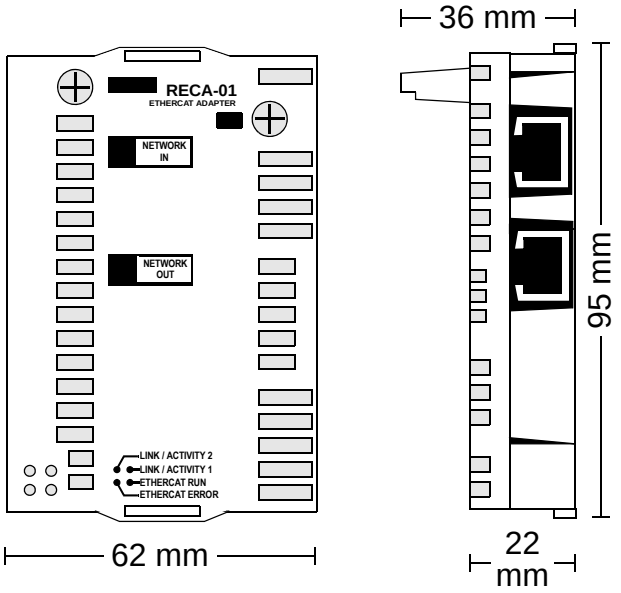

Figure 8. Enclosure of RECA-01

Mounting: Into an option slot on the control board of the drive.

Degree of protection: IP20

Ambient conditions: The applicable ambient conditions specified for the drive hardware manual are in effect.

Settings:

- Through drive parameters

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Connectors:

- 34-pin parallel bus connector
- 2 RJ-45 connectors (X1 and X2)

Current consumption:

- 290 mA average (5 V), supplied by the drive control board.

General:

- Estimated min. lifetime: 100 000 h
- All materials are UL/CSA approved.
- Complies with EMC Standards EN 50081-2 and EN 50082-2.

EtherCAT® link

Compatible devices: All EtherCAT® compliant devices

Medium: 100 base TX

- Termination: Internal
- Wiring: CAT 5 UTP, CAT 5 FTP* or CAT 5 STP*

(*Recommended)

- Connector: RJ-45
- Maximum segment length: 100 m

Serial Communication Type: Full duplex

Transfer Rate: 100 Mbit/s

Protocol: EtherCAT

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Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to ABB website and selecting *Sales, Support and Service network*.

Product training

For information on ABB product training, navigate to ABB website and select *Training courses*.

Providing feedback on ABB Drives manuals

Your comments on our manuals are welcome. Go to ABB website and select *Document Library – Manuals feedback form (LV AC drives)*.

Document library on the Internet

You can find manuals and other product documents in PDF format on the Internet. Go to ABB website and select *Document Library.* You can browse the library or enter selection criteria, for example a document code, in the search field.

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